Next Generation X-ray Polarimeter

Completed Technology Project (2015 - 2017)

Project Introduction

The emission regions of many types of X-ray sources are small and cannot be spatially resolved without interferometry techniques that haven't yet been developed. In order to understand the emission mechanisms and emission geometry, alternate measurement techniques are required. Most microphysical processes that affect X-rays, including scattering and magnetic emission processes are imprinted as polarization signatures. X-ray polarization also reveals exotic physical processes occurring in regions of very strong gravitational and magnetic fields. Observations of X-ray polarization will provide a measurement of the geometrical distribution of gas and magnetic fields without foreground depolarization that affects longer wavelengths (e.g. Faraday rotation in the radio). Emission from accretion disks has an inclination-dependent polarization. The polarization signature is modified by extreme gravitational forces, which bend light, essentially changing the contribution of each part of the disk to the integrated total intensity seen by distant observers. Because gravity has the largest effect on the innermost parts of the disk (which are the hottest, and thus contributes to more high energy photons), the energy dependent polarization is diagnostic of disk inclination, black hole mass and spin. Increasing the sensitive energy band will make these measurements possible. X-ray polarimetry will also enable the study of the origin of cosmic rays in the universe, the nature of black holes, the role of black holes in the evolution of galaxies, and the interaction of matter with the highest physically possible magnetic fields. These objectives address NASA's strategic interest in the origin, structure, and evolution of the universe. We propose a two-year effort to develop the Next Generation X-ray Polarimeter (NGXP) that will have more than ten times the sensitivity of the current state of the art. NGXP will make possible game changing measurements of classes of astrophysical sources that were previously unobtainable within realistic observation times e.g. Active Galactic Nuclei (AGN). Standard photoelectric X-ray polarimeter designs are both quantum efficiency (QE) limited and challenging to calibrate due to diffusion of electron signal as it drifts through the gas. Drifting negative ions decreases diffusion to the thermal limit thereby decoupling sensitivity from drift distance and enabling larger detector areas that can be at the focus of larger diameter mirrors and single reflection concentrator optics. NITPCs also allow the selection of constituent gasses and pressures to be based on the optimization of modulation and QE rather than diffusion properties. This versatility enables a large improvement in sensitivity without driving cost and with only moderate increase to mass and power of the detector and/or instrument. Furthermore, the energy band of NGXP will be tunable to maximize the science return. Following the efforts of this proposal NGXP will be proposed as sounding rocket experiment and as a candidate instrument for future opportunities. The GSFC polarimeter group has demonstrated NITPCs for several detector concepts. This proposal leverages the previous effort and team expertise with goals to establish the NITPC as the baseline for narrow field observations of faint persistent sources and to improve the technology readiness of associated

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Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

Responsible Program:

Astrophysics Research and Analysis

Project Management

Program Director:

Michael A Garcia

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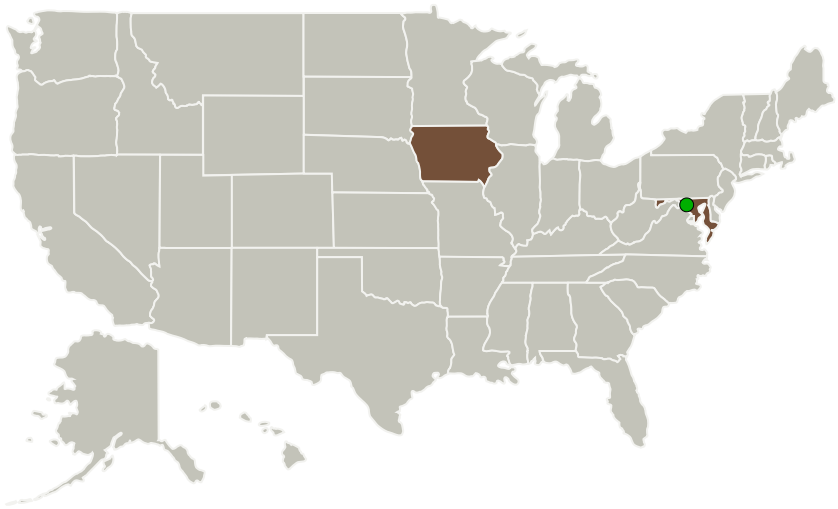
technologies such as stainless steel gas electron multipliers and finer readout pitch.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Goddard Space Flight Center(GSFC)	Supporting Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations	
Iowa	Maryland

Project Management *(cont.)*

Program Manager:

Dominic J Benford

Principal Investigator:

Joe Hill-kittle

Co-Investigators:

Jeremy D Schnittman
Philip E Kaaret
Keith M Jahoda
David T Leisawitz
Kevin Black

Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.1 Detectors and Focal Planes

Target Destination

Outside the Solar System